# APPARATUS AND SYSTEM FOR TESTING AN IMAGE PRODUCED BY A HELMET-MOUNTED DISPLAY

This application is a continuation of U.S. patent application Ser. No. 09/703,426, filed on Oct. 31, 2000, which claims the benefit of U.S. provisional application Ser. No. 60/239,496, filed on Oct. 11, 2000. Each of the foregoing applications is incorporated herein by reference.

## I. FIELD OF THE INVENTION

The present invention relates generally to helmet-mounted displays and more particularly to testing quality and accuracy of images produced by helmet-mounted displays.

## II. BACKGROUND OF THE INVENTION

Helmet-mounted displays (HMDs), in general, are systems which allow their operators, for example, pilots, battle tank operators, firefighters and others to integrate themselves with their environment. HMDs will generally have one or more unique features depending upon the environment in which they are deployed. One feature which an HMD may have is the capability to allow a human to see beyond the limitations of normal human vision, for example, forward looking infrared radar (FLIR) systems, (which use infrared waves which ordinarily cannot be seen by the human), radar and image intensification, to construct and project a picture which a human pilot, for example, can see. HMDs may also be integrated with helicopter weapons control (for example, integrated such that the visual display of the HMD is integrated with the gun sights of weapons on a helicopter).

One example of an HMD is the Integrated Helmet and Display Sighting system (IHADSS), manufactured by Honeywell, Inc. and used in the U.S. Army's AH-64 Apache helicopter. (For ease of understanding, the present discussion will refer throughout to the IHADSS, but it will be recognized by those having ordinary skill in the art that the IHADSS is intended to be representative of the more general HMDs above.)

The IHADSS typically gathers information related to the terrain and environment in which the aircraft is operating by using cameras and/or sensors affixed to the aircraft. Thereafter, the IHADSS processes the gathered information into a form which can be seen by a human pilot, and thereafter projects the gathered and processed information as images via an assortment of electronic and optical apparatuses (described in more detail below) into a pilot's field of view. In many instances, a pilot of an aircraft is flying the aircraft or targeting the aircraft's weapons systems on the basis of the images displayed by the IHADSS. Accordingly, it is imperative that each individual IHADSS project a clear and accurate depiction of the terrain and/or environment captured by its associated cameras and sensors. Consequently, it is important that the images produced by the IHADSS be clear and accurate. Unfortunately, the integration of each individual IHADSS with the systems and subsystems of aircrafts in which each individual IHADSS is deployed makes it difficult to ensure that each individual IHADSS is projecting a clear, accurate, and quality depiction of the terrains and/or environments (via produced images) captured by its associated cameras and sensors. This difficulty is due in large part to a lack of effective methods and systems for the testing of the accuracy and quality of IHADSS imagery in a field environment.

At present, when an IHADSS is deployed in a field environment, the accuracy and quality of the deployed IHADSS



imagery is determined on a subjective basis by each pilot viewing the IHADSS' display device. Such a methodology is suboptimal for several reasons. One reason why such methodology is suboptimal arises from interaction of the gradual degradation of the IHADSS with the adaptability of the human visual system. Over time it is common for the visual displays of IHADSS to gradually degrade and become distorted for various reasons, for example, aging of the electronics, routine wear and tear, shock and vibration, etc. It has been discovered that in practice, an IHADSS display can be substantially degraded without such degradation being detectable by the pilot, because insofar as each IHADSS is typically tuned by a specific pilot, and insofar as the degradation of the IHADSS over time is often gradual, the adaptability of the human visual system often tricks the pilot into thinking the IHADSS display is accurate and/or acceptable when in fact it is substantially inaccurate and/or unacceptable. Another reason why the current methodology is suboptimal arises from the lack of accuracy and/or reproducibility generally associated with subjective approaches.

In light of the foregoing, it is clear that a need exists for a method and system for objectively and accurately testing the quality of images produced by an individual IHADSS.

## III. SUMMARY OF THE INVENTION

The present invention relates to a system and method for testing the quality of an image produced by a helmet-mounted display (HMD). For example, the present invention may be utilized to test the quality of an image produced by a display sighting system such as the Integrated Helmet and Display Sighting System (IHADSS) used by pilots of helicopters or firemen blinded by a fire. In at least one embodiment, after an image is captured, for example, at least one measurable aspect of the image is analyzed in an objective manner to determine at least one possible difference in the measurable aspect of the image and a corresponding measurable aspect of a reference image and presenting the difference on a visual display device. The analyzing process may be accomplished by employing a variety of computational algorithms to aid in the above-referenced difference determination. Such a determination may aid a pilot in allowing the pilot to have a more accurate representation of his surrounding environment, thereby reducing risk to the pilot's life.

## IV. BRIEF DESCRIPTION OF THE DRAWINGS

The use of cross-hatching or shading within these drawings should not be interpreted as a limitation on the potential materials used for construction. Like reference numerals in the figures represent and refer to the same element or function.

FIG. **1** illustrates a perspective view of a pilot wearing an Integrated Helmet Unit (IHU) according to at least one embodiment of the invention.

FIG. **2** illustrates a perspective view of a Helmet Display Unit (HDU).

FIG. **3**A illustrates a perspective view of a positioning device in which the HDU is placed to capture an image for testing according to at least one embodiment of the invention.

FIG. **3**B illustrates a perspective view of the positioning device in conjunction with cameras used to capture an image for testing according to at least one embodiment of the invention.

FIG. **4** illustrates a block diagram of a method for objectively testing quality of an image according to at least one embodiment of the invention.